



A new grenadier of the genus *Nezumia* (Pisces: Gadiformes: Macrouridae) from southern Japan

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Abstract

A new grenadier, *Nezumia shinoharai*, is described based on two specimens collected from the continental slope off the Pacific coast of southern Japan, at depths of 627–700 m. The new species is clearly distinguished from all other congeners by the following combination of characters: pelvic fin rays 10; spinules on body scales needlelike, arranged in discrete parallel rows; underside of head almost completely naked with prominent sensory pores; teeth in broad cardiform bands in both jaws; snout long (31–34% HL), conically pointed, protruding well beyond upper jaw; first dorsal fin uniformly dark with pale distal tip, second spinous ray not extremely elongated (height of first dorsal fin about equal to HL); no dark band encircling trunk.

Key words: *Nezumia shinoharai* sp. nov., taxonomy, deep-sea fish, northwestern Pacific

Introduction

Grenadiers of the genus *Nezumia* contains more than 40 species mainly inhabiting the continental slope, seamounts, and ridges in tropical and temperate waters of the world oceans (Iwamoto, 1990; Sazonov and Iwamoto, 1992; Wilson, 2001). Several species previously treated as *Nezumia* were subsequently transferred to other genera, *Kuronezumia* and *Kumba* (Sazonov and Iwamoto, 1992; Iwamoto and Sazonov, 1994). *Nezumia* is currently characterized by the following features: branchiostegal rays 7; anus closer to pelvic fin bases than to anal fin origin; a small dermal window of light organ lying between pelvic fin bases; tip and lateral angles of snout armed with prominent scutes; suborbital shelf formed of coarsely modified scales; second spinous ray of first dorsal fin serrated along leading edge (Sazonov and Iwamoto, 1992; Iwamoto and Merrett, 1997; Iwamoto and Williams, 1999; Iwamoto and Graham, 2001).

During our ongoing study of Japanese grenadiers, a small specimen of *Nezumia* collected from Tosa Bay, Shikoku, at a depth of 700 m, was found among the ichthyological collection of the Laboratory of Marine Biology, Faculty of Science, Kochi University (BSKU). The specimen is in relatively poor condition with almost all body scales missing and tip of first dorsal fin broken. Although it was chiefly recognized as an undescribed species by the combination of naked area on underside of head, spinulation on body scales, and several meristic and morphometric characters, we were reluctant to describe it until more or better material become available. In February 2010, a workshop was held at the National Museum of Nature and Science, Tokyo (NSMT) to identify and register a large collection of deep-sea fishes collected around Japan and recently transferred from the National Research Institute of Far Seas Fisheries, Shizuoka (FSFL) and the Atmosphere and Ocean Research Institute, the University of Tokyo, Chiba (AORI). During the workshop, the first author found another well-preserved specimen of the undescribed *Nezumia* collected from east of Boso Peninsula, Honshu, at a depth of 627–673 m. The purpose of this paper is to describe the two specimens as representatives of a new species.

Material and methods

Methods for making counts and measurements follow procedures described by Iwamoto (1970) and Iwamoto and Sazonov (1988). Head and total lengths are expressed as HL and TL, respectively. Terminology of cephalic sensory system is defined in Fig. 3. Institutional abbreviations follow Fricke and Eshmeyer (2011).

Nezumia shinoharai sp. nov.

New English Name: Shinohara's grenadier

New Japanese Name: Shinohara-hige

(Figs. 1–4; Table 1)

Holotype. NSMT-P 97667 (38.0 mm HL, 244+ mm TL), east of Boso Peninsula, 35°06.29'N, 140°50.2'E, 627–673 m depth, R/V *Tansei-maru*, cr. KT-95-15, sta. TB16, 3-m ORE beam trawl, 25 Apr. 1995.

Paratype. BSKU 44790 (33.3 mm HL, 198+ mm TL), Tosa Bay, 33°03.10'N, 133°36.91'E, 700 m depth, FRV *Kotaka-maru*, otter trawl, 24 May 1988.

Diagnosis. A species of *Nezumia* with the following combination of characters: pelvic fin rays 10; body scales covered with long, reclined, needlelike spinules in discrete parallel rows, posteriormost spinules extending well beyond scale margin; underside of head almost completely naked; cephalic sensory pores well developed especially on mandibular and infraorbital canals; teeth in broad cardiform bands in both jaws; snout long (31–34% HL), protruding well beyond upper jaw, ventral profile oblique; first dorsal fin uniformly dark with pale distal tip, second spinous ray not extremely elongated (height of first dorsal fin 99% HL); no prominent dark band encircling trunk.



FIGURE 1. Holotype of *Nezumia shinoharai* sp. nov. NSMT-P 97667, 38.0 mm HL, 244+ mm TL. Lateral view of preserved specimen. Scale bar = 20 mm.

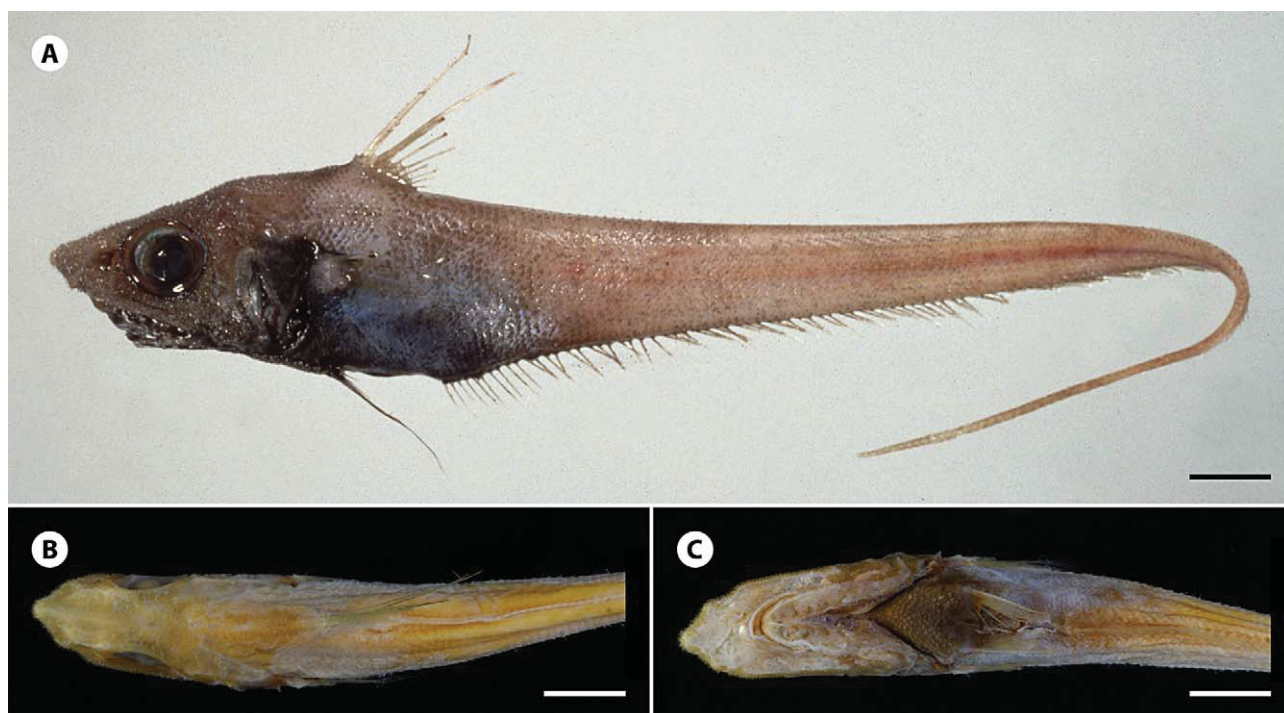


FIGURE 2. Paratype of *Nezumia shinoharai* sp. nov. BSKU 44790, 33.3 mm HL, 198+ mm TL. (A) lateral view of fresh specimen; (B) dorsal and (C) ventral views of preserved specimen. Scale bar = 20 mm.

Description. Data for the holotype are presented first, followed by those for the paratype, if different, in parentheses (see also Table 1). Pectoral fin rays i20–i21 (i23–i24); gill rakers on first arch (outer/inner) 9/11 (9/10); gill rakers on second arch 10/11 (10/10); lateral line scales over distance equal to predorsal length 38 (39); branchiostegal rays 7. The followings in percent of HL: snout length 31 (34); orbit diameter 30 (29); postrostral length 69 (68); upper jaw length 26 (27); internasal width 22; body depth at origin of first dorsal fin 80 (71); prepelvic length 102 (105); preanal length 134 (142); distance from isthmus to pelvic fin base 36 (35); distance from pelvic fin base to anal fin origin 37 (41); distance from anus to anal fin origin 24 (23); pelvic fin length 62 (65); pectoral fin length 55 (52); predorsal length 116 (113); length of first dorsal fin base 28 (23); interspace between first and second dorsal fins 41 (39).

General features shown in Figs. 1 and 2. Body long, slender, gradually tapering from level of first dorsal fin to end of tail. Trunk short, laterally compressed, width over pectoral fin bases about 1.7 in depth below origin of first dorsal fin. Head rather short, about 6.5 in TL. Dorsal profile of head almost straight from tip of snout to nape. Snout long, protruding well beyond upper jaw, bluntly pointed in lateral and dorsal views. Ventral profile of snout oblique, forming an angle of about 45° to horizontal axis of head and body. Orbit large, circular, greatest diameter slightly shorter than snout length. Interorbital space gently depressed in preserved condition. Suborbital region moderately broad, divided into upper and lower parts by a longitudinal ridge. Mouth relatively small and inferior, about equal to or slightly shorter than interorbital width; upper jaw extending to below posterior 1/3 of orbit; posterior end of rictus slightly restricted by a lip fold. Lips relatively thick, papillaceous near teeth. Preopercle large, its hind margin inclined slightly backward and broadly rounded posteroventrally; preopercular ridge relatively low, forming a moderate backward extension at angle. Interopercle narrowly exposed beyond preopercle. Gill opening relatively narrow, extending forward to vertical under posterior margin of orbit; gill membranes broadly attached across isthmus with a posterior free fold. Outer and innermost gill slits restricted by folds of skin attached to upper and lower ends of gill arch. Gill rakers developed into short, spinous tubercles; those of outer series on first arch somewhat smaller. Barbel moderately long, terminating into a fine distal tip.

Anus and urogenital opening surrounded by a narrow periproct (black naked skin) that is situated closer to inner bases of pelvic fin than to origin of anal fin. Anterior dermal window of light organ small, narrow, extending from periproct to just behind a line connecting outer bases of pelvic fin.

TABLE 1. Selected counts and measurements of five species of *Nezumia*.

	<i>N. shinoharai</i> <i>n</i> =2	<i>N. merretti</i> <i>n</i> =3	<i>N. aspidentata</i> <i>n</i> =1	<i>N. holocentra</i> <i>n</i> =15	<i>N. spinosa</i> <i>n</i> =8
TL (mm)	244+ (198+)	203+–244+	193	151+–181+	130–262+
HL (mm)	38.0 (33.3)	36.7–54.3	34.2	30.9–39.6	19.4–48.8
% of HL					
Postorbital length	42 (39)	38–46	39	43–45	28–32
Distance from orbit to preopercle	35 (34)	32–33	30	35–37	35–40
Suborbital width	15 (14)	12–13	13	11–13	11–16
Preoral length	29 (30)	23–31	27	19–22	18–22
Interorbital width	25 (23)	19–21	21	18–20	19–21
Height of 1st dorsal fin	99	115	102	98–119	120–123
Length of outer gill slit	14 (12)	12–14	10	11–13	10–14
Length of barbel	12 (11)	6–12	6	7–11	9–14
Counts					
1st dorsal fin rays	II,9	II,10–11	II,8	II, 9–11	II,8–10
Pelvic fin rays	10	8–9	10	9	8
Scales below 1D midbase*	7.5	5.5	8.5	6.5–7.5	5.5–9
Scales below 2D origin**	9 (8)	6.5–8	9	8.5–9.5	7.5–8.5

*Transverse scale rows from midbase of first dorsal fin to lateral line

**Transverse scale rows from origin of second dorsal fin to lateral line

Teeth long, slender, conical, in broad tapered bands in both jaws; premaxillary band widest near symphysis with about seven teeth rows, extending almost 3/4 length of rictus; outer series distinctly enlarged. Dentary band similar to those of premaxillary, but no teeth significantly enlarged. All teeth deeply embedded in thick layer of gum papillae.

Body fully scaled except for periproct and anterior dermal window. Scales on body small, thin, relatively deciduous, covered with long, reclined, needlelike spinules in discrete parallel rows; those on dorsum below inter-dorsal space with 7 or 8 spinule rows; height of spinule on each row gradually increasing posteriorly, the last spinule extending well beyond scale margin; reticulate structure moderately developed on posterior part of unexposed field. Scales behind first dorsal, pectoral, and pelvic fins, and beneath gill covers lacking spinules. Grooved lateral line well developed, not interrupted throughout. Fins completely naked except proximal part of pelvic fin densely covered with minute scales.

Head mostly scaled except for lips, chin barbel, gular and branchiostegal membranes, and a narrow region around anterior nostril. Paired T-shaped areas on dorsal surface of snout narrowly naked. Underside of head naked from tip of snout to below posterior margin of suborbital shelf, the naked area extending onto lower margin of preopercle and entire mandibular ramus. Scales on head generally similar to those on body, except that spinules more erect and arrayed in somewhat divergent rows. Snout tipped with two large, closely adjoined tubercles; lateral angles armed with stout scutelike scales. Suborbital shelf formed of three rows of coarsely modified scales.

Cephalic sensory canals developed, but not broaden or swollen. Counts of open pores as follows (Fig. 3): mandibular pores 7; preopercular pores 6; infraorbital pores 9; supraorbital pores 2; occipital pores 1; temporal pores 5; supratemporal pores 2. Pores on underside of head prominently enlarged; those on dorsal and lateral surfaces relatively small. Superficial neuromasts serially arranged along supraorbital, infraorbital, and mandibular canals, but densely scattered on underside of snout. Neuromasts below leading edges of snout modified to large knoblike papillae. Anterior nostril small and circular; posterior nostril large and bean-shaped; septum separating both nostrils forming an anteriorly-opened hood. Olfactory bulb oval, formed of 24–28 lamellae.

First dorsal fin short based, originating slightly behind vertical through pectoral fin insertion; first spinous ray splintlike, closely adhered to second spinous ray; second spinous ray fairly long, about equal to HL, armed along leading edge with small, sharp, reclined denticles. Interspace between first and second dorsal fins moderately wide,

nearly equal to postorbital length. Second dorsal fin poorly developed, originating above base of eighth or ninth anal fin ray. Pectoral fin moderately short; upper base on a longitudinal line passing through midorbit. Pelvic fin inserted just below pectoral fin base; outermost ray slightly prolonged, extending backward to base of eighth to tenth anal fin ray. Anal fin well developed, much higher than second dorsal fin.

Coloration. In 75% ethanol, ground color tawny to swarthy. Chest black. Abdomen dusky violet. Underside of head generally black, except for pale chin. Orbit marked with a narrow dark rim. Lips mostly pallid, but sharply delineated in black. Barbel pale, but darker at base. Oral cavity uniformly black, except for pale gum papillae. Gill chamber mostly black, but paler on ceratohyal, epihyal, and anterior to lower end of cleithrum; gill rakers and arches dark; gill filaments pale. First dorsal fin uniformly dark with pale tip; second dorsal fin immaculate overall; pectoral fin dusky with a small black spot near lower base; pelvic fin uniformly black; anal fin dark anteriorly, but paler posteriorly. Color when fresh (based on photograph of the paratype; Fig. 2) almost same as that in preserved specimens, but much darker overall.

Distribution. *Nezumia shinoharai* is currently known only from off Boso Peninsula and Tosa Bay, southern Japan, at depths of 627–700 m.

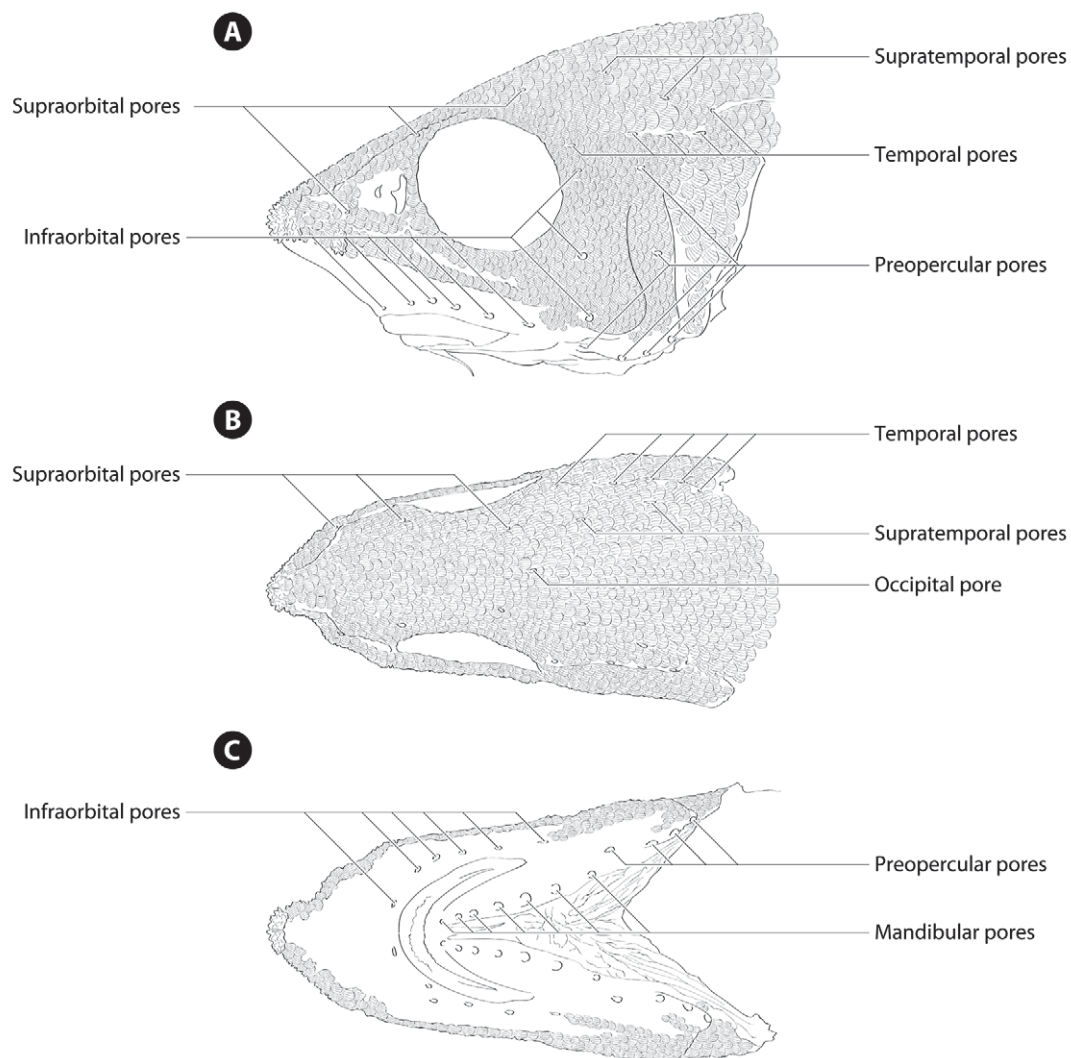


FIGURE 3. Illustrations showing cephalic sensory pores and head squamation of *Nezumia shinoharai* **sp. nov.**, holotype, NSMT-P 97667, 38.0 mm HL, 244+ mm TL. (A) lateral view; (B) dorsal view; and (C) ventral view.

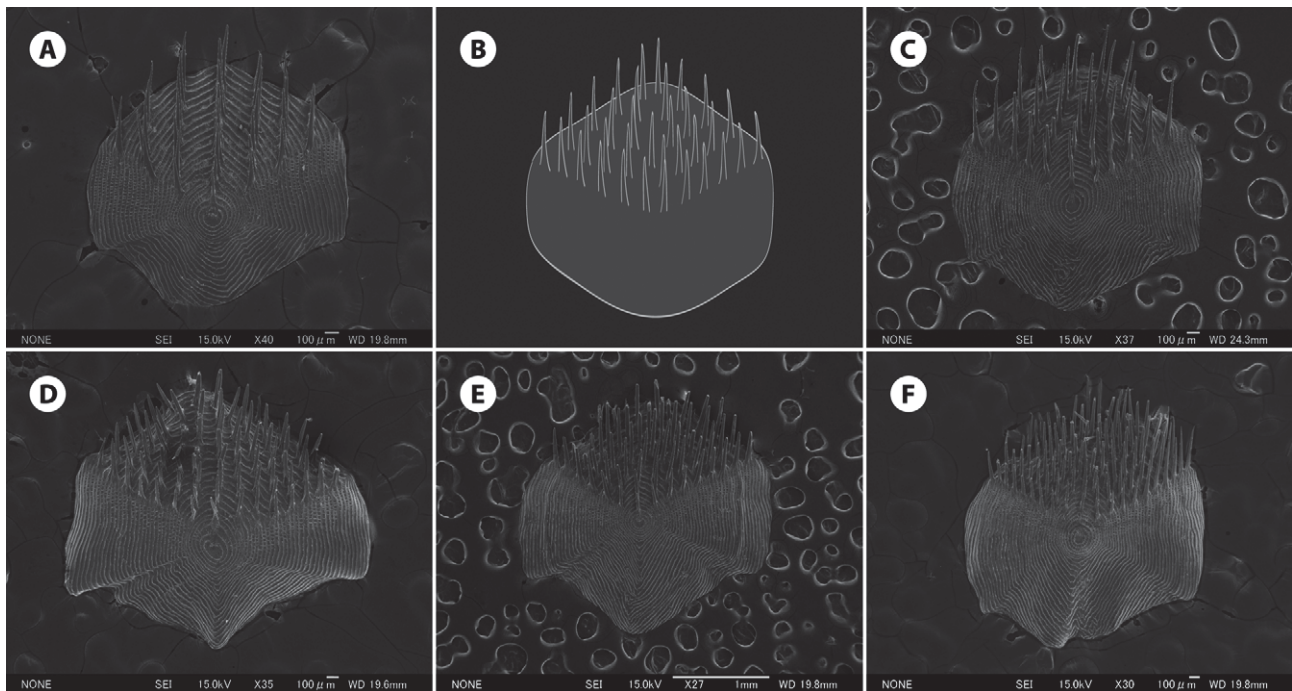


FIGURE 4. Body scales of five species of *Nezumia*. (A) *N. shinoharai* **sp. nov.**, holotype, 38.0 mm HL; (B) *N. aspidontata*, MNHN 1996-0958, holotype, 34.2 mm HL; (C) *N. holocentra*, BPBM 27579, 38.6 mm HL; (D) *N. merretti*, CSIRO H 1966--01, paratype, 39.3 mm HL; (E) *N. spinosa*, USNM 76868, holotype, 46.4 mm HL; and (F) *N. spinosa*, CSIRO H2594--10, 48.8 mm HL. All scales are from region below interspace between first and second dorsal fins.

Etymology. The new species is named in honor of Dr. Gento Shinohara of the National Museum of Nature and Science, Tokyo, for his great contributions to our knowledge of the deep-sea fish fauna around Japan.

Remarks. Since both the holotype and paratype of *N. shinoharai* were collected by bottom trawls, some of their characters are partially damaged. The holotype is in excellent condition but with a damaged abdomen where the intestine is exposed to the outside (Fig. 1). In the paratype, the tip of first dorsal fin is broken and no body scales remain except on the isthmus and predorsal region. Compared to the larger holotype, the paratype has a higher count of pectoral fin rays (i23–i24 vs. i20–i21) and fewer and rather widely spaced serrations along leading edge of first dorsal fin. We conclude that these differences are attributed to individual and size-related variations, respectively, and the gaps will be filled when more specimens become available.

Among more than 40 species of the genus, *N. shinoharai* is most similar to the following four species: *N. aspidontata* Iwamoto and Merrett, 1997 currently known only from the holotype from New Caledonia; *N. holocentra* (Gilbert and Cramer, 1897) distributed in the Hawaiian Archipelago; *N. merretti* Iwamoto and Williams, 1999 known from three specimens including the two types from the Western Australia and an additional specimen recently collected from the eastern Indian Ocean off Indonesia (HUMZ 190198); *N. spinosa* (Gilbert and Hubbs, 1916) widely distributed from Japan (type locality) to Australia as well as southern Africa. The five species share the following features: snout long, protruding well beyond upper jaw; pelvic fin rays 8–10; underside of head almost entirely naked with prominent open pores; teeth in both jaws in broad cardiform bands; no dark band encircling trunk.

Nezumia shinoharai is distinguished from all of these species by its unique spinulation on body scales, viz., spinules are long, extending well beyond the scale margin, and arranged in discrete parallel rows (Fig 4). In *N. aspidontata* and *N. holocentra*, spinules are arrayed in convergent rows. In *N. merretti*, they are much shorter, not overlapping the scale margin as extensively, and arranged in more tightly parallel rows. In their original description of *N. spinosa*, Gilbert and Hubbs (1916) provided an excellent illustration of the holotype where body scale spinules are arranged in parallel to convergent rows (pl. 10, fig. 2), although they noted that “scales with long retrose spinules, arranged in quincunx order”. This illustration was subsequently used by Iwamoto and Merrett (1997) and Iwamoto and Williams (1999). Based on our examination of the holotype of *N. spinosa*, body scales are covered with numerous spinules densely scattered over the exposed field (Fig. 4E). The new species further differs

from *N. holocentara*, *N. merrettii*, and *N. spinosa* in having 10 pelvic fin rays (vs. 8 or 9), and from *N. aspidontata* in having more prominent sensory pores especially on the infraorbital and mandibular canals. Several measurements given in Table 1 are also useful for separating the new species from the other four.

Iwamoto and Williams (1999) noted notable differences in frequency distributions of several counts and measurements between Australian and African populations of *N. spinosa*, suggesting these populations may represent different species with disjunct distributions. In addition to the differences of body scale structure and pelvic fin ray count mentioned above, the new species is further distinguished from our materials of *N. spinosa* including the holotype, one from the South China Sea, and six from Australia, in having a lower first dorsal fin (99% HL vs. 120–138%), a longer preoral length (29–30% vs. 18–26%), and a shorter postorbital length (39–42% vs. 44–47%).

Nezumia shinoharai is extremely rare in Japanese waters, considering how thoroughly the region has been explored over the past century. Although Tomio Iwamoto of the California Academy of Sciences and the present authors have checked extensive collections deposited in BSKU, NSMT, HUMZ, FAKU, and ZMUT, no additional specimens of this species were found.

Comparative material examined. *Nezumia aspidontata*: MNHN 1996-0958 (holotype, 34.2 mm HL, 193 mm TL), off New Caledonia, 19°39.0'S, 158°49.0'E, 700–720 m depth, 18 Oct. 1986. *N. holocentara*: USNM 47723 (questionable paratype, 39.6 mm HL, 171+ mm TL), off Hawaii, 21°12'00"N, 157°38'30"W, 686 m depth, 6 Dec. 1981; BPBM 24579 (5 specimens, 35.7–38.6 mm HL, 151+–181+ mm TL), off Hawaii, 650 m depth, 10 Mar. 1971. *N. merrettii*: CSIRO H 2584--20 (holotype, 54.3 mm HL, 244+ mm TL), off Western Australia, 18°04'S, 112°42'E, 853–854 m depth, 1 Feb. 1991; CSIRO H 1966--01 (paratype, 39.3 mm HL, 203+ mm TL), off Queensland, 18°59'S, 150°32'E, 879–886 m depth, 25 Nov. 1985; HUMZ 190198 (1, 36.7 mm HL, 183+ mm TL), north-west of Sumatra Island, 5°29.16'N, 93°44.14'E, 568–590 m, 13 Oct. 2004. *N. spinosa*: USNM 76868 (holotype, 46.4 mm HL, 262+ mm TL), East China Sea, 31°31'N, 129°25'30"E, 781 m depth, 12 Aug. 1906; BSKU 16687 (1, 35.5 mm HL, 183+ mm TL) and BSKU 16688 (1, 19.4 mm HL, 130 mm TL), Timor Sea, 9°27.0'S, 127°58.6'E, 690–850 m depth, 18–19 Jun. 1972; CSIRO H 1961--01 (1, 40.4 mm HL, 197+ mm TL), off Queensland, 18°54'S, 150°29'E, 1005–1013 m depth, 25 Nov. 1985; CSIRO H 1971--01 (1, 40.8 mm HL, 199+ mm TL), off Queensland, 16°55'S, 151°34'E, 880 m depth, 6 Dec. 1985; CSIRO 2549--10 (1, 48.8 mm HL, 254+ mm TL), off Western Australia, 21°51'S, 113°46'E, 650–685 m depth, 24 Jan. 1991; CSIRO 2580--04 (1, 47.5 mm HL; 249+ mm TL), off Western Australia, 27°06'S, 112°22'E, 713–714 m depth, 31 Jan. 1991; SFC 1840 (1, 37.0 mm HL, 176+ mm TL), South China Sea, 604–680 m depth, Apr. 1982.

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References

- Fricke, R. & Eschmeyer, W.N. (2011) A guide to fish collections in the Catalog of Fishes. Available from: <http://researcharchive.calacademy.org/research/ichthyology/catalog/collections.asp>. (accessed 9 November 2011).
- Gilbert, C.H. & Cramer, F. (1897) Report on the fishes dredged in deep water near the Hawaiian Islands, with descriptions and figures of twenty-three new species. *Proceedings of the United States National Museum*, 19, 1114, 403–435, pls. 36–48.
- Gilbert, C.H. & Hubbs, C.L. (1916) Report on the Japanese macrouroid fishes collected by the United States fisheries steamer "Albatross" in 1906, with a synopsis of the genera. *Proceedings of the United States National Museum*, 51, 2149, 135–214,

pls. 8–11.

- Iwamoto, T. (1970) The R/V Pillsbury Deep-Sea Biological Expedition to the Gulf of Guinea, 1964–65. 19. Macrourid fishes of the Gulf of Guinea. *Studies in Tropical Oceanography*, 4, 316–431.
- Iwamoto, T. (1990) Family Macrouridae. In: Cohen, D.M., Inada, T., Iwamoto, T. & Scialabba, N. (Eds.) *FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis no. 125*. FAO, Rome, pp. 90–317.
- Iwamoto, T. & Graham, K.J. (2001) Grenadiers (families Bathygadidae and Macrouridae, Gadiformes, Pisces) of New South Wales, Australia. *Proceedings of the California Academy of Sciences*, 52, 407–509.
- Iwamoto, T. & Merrett, N.R. (1997) Pisces Gadiformes: taxonomy of grenadiers of the New Caledonian region, southwest Pacific. In: Crosnier, A. (Ed.), *Résultats des Campagnes MUSORSTOM*, vol.18. *Mémoires du Muséum national d'Histoire naturelle*, 176, 473–570.
- Iwamoto, T. & Sazonov, Y.I. (1988) A review of the southeastern Pacific *Coryphaenoides* (sensu lato) (Pisces, Gadiformes, Macrouridae). *Proceedings of the California Academy of Sciences*, 45, 35–82.
- Iwamoto, T. & Sazonov, Y.I. (1994) Revision of the genus *Kumba* (Pisces, Gadiformes, Macrouridae), with description of three new species. *Proceedings of the California Academy of Sciences*, 48, 221–237.
- Iwamoto, T. & Williams, A. (1999) Grenadiers (Pisces, Gadiformes) from the continental slope of western and northwestern Australia. *Proceedings of the California Academy of Sciences*, 51, 105–243.
- Iwamoto, T., Ho, C.-H. & Shao, K.-T. (2009) Description of a new *Coelorinchus* (Macrouridae, Gadiformes, Teleostei) from Taiwan, with notable new records of grenadiers from the South China Sea. *Zootaxa*, 2326, 39–50.
- Sazonov Y.I. & Iwamoto, T. (1992) Grenadiers (Pisces, Gadiformes) of the Nazca and Sala y Gomez ridges, southeastern Pacific. *Proceedings of the California Academy of Sciences*, 48, 27–95.
- Wilson, R.R., Jr. (2002) A new species of *Nezumia* (Gadiformes: Macrouridae) from Fieberling Guyot, Eastern North Pacific Ocean. *Revista de Biología Tropical*, 49 (supplement 1), 29–37.